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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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R C van Dijk

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(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Light-transmitting subtrate provided with a light-absorbing coating

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Light-transmitting substrate provided with a light-absorbing coating

The present invention relates to a light-transmitting substrate that is at least partly provided with a light-absorbing coating, said coating comprising a pigment which absorbs part of the visible light. The invention further relates to an electric lamp comprising a light-transmitting lamp vessel that accommodates a light source, wherein said lamp vessel comprises the above light-transmitting substrate. Furthermore the present invention relates to the light absorbing coating itself.

Light-transmitting substrates provided with a light absorbing coating can be used as a color layer on or in front of (incandescent) lamps for general lighting purposes. The substrate may comprise, for example, a colored filter made of a - flat or non-flat shaped - piece of glass, which is designated to be placed on trajectory of light, said light being generated by a lamp. Such application is often used in outdoor lighting. Another example of a light-transmitting substrate is a lamp vessel that is placed over a light source of an electric lamp. Such electric lamps are predominantly used as indicator lamps in vehicles, for example as red-colored light source in red tail and brake lights of automobiles. Said electric lamps can also be used in traffic lights.

The pigments in the light-absorbing coating can scatter the light coming from the lamp filament. In case the light-absorbing coating is applied on the lamp vessel of an electric lamp that is placed in an automotive luminaire, the scattering effect can be a real problem for the efficiency of such automotive luminaire. The automotive luminaire is designed to reflect the light coming from the filament of the lamp. If the light-absorbing coating on the lamp bulb is scattering the light, the lamp bulb itself can also be seen as a light source. The light is then distributed differently within the luminaire resulting in a bad beam pattern of the light on the road.

The present invention aims to provide for a light-transmitting substrate according to the preamble, in which the above mentioned disadvantages are obviated. Moreover, the present invention aims to provide for a coating that does not show the above mentioned disadvantages.

To this end, the present invention provides for a light-transmitting substrate according to the preamble that is characterized in that aluminum oxide is added to the coating during preparation thereof.

By adding aluminum oxide to the pigment dispersion during preparation thereof, the aluminum oxide acts as a grinding aid. This results in a smaller particle size distribution of the pigments and therefore in a reduction of the scattering of the coating.

The hardness index of aluminum oxide is 9. This means that aluminum oxide is a very hard material. To this end reference is made to diamond, iron oxide and organic pigments, which have hardness indices of 10, 5.5 and less than 5, respectively.

The aluminum oxide not only aids in a reduced scattering of the coating, it also acts as a stabilizer for the pigments in the coating. The aluminum oxide prevents pigments to agglomerate during the application and curing process.

Another effect of the addition of aluminum oxide to the pigments in the coating is that the temperature stability thereof is significantly increased. The colorpoint shift of lamps without aluminum oxide in the coating is larger than the colorpoint shift of lamps with aluminum oxide in the coating.

In particular, the aluminum oxide has a particle size of 10-40 nm, preferably 20-30 nm.

A source of Al_2O_3 that is advantageously used is Alon-C from Degussa®.

In a preferred embodiment of the invention, the light-absorbing coating comprises pigment particles that are incorporated in a sol-gel matrix.

EP-A-1 129 470 in the name of the Applicant discloses a light-absorbing coating that comprises pigment particles incorporated in a sol-gel matrix. Such coating can resist temperatures up to 400°C and can be made in relatively thick layers.

In a particular embodiment, the pigment in the light-absorbing coating comprises an organic pigment.

Generally, organic pigments give a relatively high lumen output on lamps, but have low temperature stability. On the other side, inorganic pigments give a relatively low lumen output, but have higher temperature stability. This applies, for example, to red colored lamps for automotive applications. Another problem of pigments is that they suffer from a thermochromic effect, which means that the transmission - or lumen output – of a colored coating decreases as a function of temperature.

Organic pigments that can be used comprise, but are not limited to, Pigment Red 177 (anthraquinone), Pigment Red 264 (diketo-pyrrolo-pyrrole), Pigment Red 166 (azo

condensation) or Chromophtal Yellow (3RT). Further suitable pigments are Red 149 (perylene), Red 122 (quinacridone), Red 257 (Ni-isoindoline), Violet 19 (quinacridone), Blue 15:1 (Cu-phthalocyanine), Green 7 (hal.Cu-phthalocyanine) or Yellow 83 (dyaryl) from "Clariant".

Also mixtures of inorganic and organic pigments are very suitable, for example a mixture of Chromophtal Yellow (3RT) and (zinc)iron oxide, or a mixture of Sicotrans Red 2816L and iron oxide.

The present invention also relates to an electric lamp comprising a light-transmitting lamp vessel which accommodates a light source, said lamp vessel comprising a light-transmitting substrate according to the above.

In this case at least part of the lamp vessel is provided with the above light-absorbing coating.

As mentioned in the above, said electric lamps can advantageously be used as indicator lamps in vehicles, for example as red-colored light source in red tail and brake lights of automobiles. However, the lamp vessel of the electric lamp can also be coated with an amber coating, thereby providing for an amber-colored light source.

Moreover, the present invention relates to a light absorbing coating according to the above.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

In the drawings:

Fig. 1 is a side view, partly cut away and partly in cross-section, of an electric lamp in accordance with the invention comprising a lamp cap;

Fig. 2 shows an electric lamp provided with a reflector and an adapter;

Fig. 3 schematically shows a cross-section of the light absorbing coating according to the invention, applied on a glass substrate;

Fig. 4 shows a graph in which the diffuse transmission of two coatings is represented; and

Fig. 5 shows the result of luminance measurements determining the "haze" of coatings.

The Figures are purely schematic and not drawn to scale. Particularly for clarity, some dimensions are exaggerated strongly. In the Figures, like reference numerals refer to like parts whenever possible.

Fig. 1 shows an electric lamp in accordance with the invention, a part of which is shown in side view, partly cut away, and another part of which is shown in cross-section. The electric lamp comprises a light-transmitting lamp vessel 1, for example made of glass, which is closed in a gastight manner and in which an electric element 2, being a (spiral-shaped) tungsten incandescent body with a center 4 in the Figure, is axially positioned on an axis 5 and is connected to current conductors 6 which issue from the lamp vessel to the exterior. The lamp shown has a filling of an inert gas, for example an Ar/Ne mixture, with a filling pressure slightly above 5 bar.

A lamp cap 10 is firmly connected to the lamp vessel 1. The lamp cap 10 has a synthetic resin housing 11. The housing 11 comprises a flat base portion 7 that is at least substantially perpendicular to the axis 5. The lamp vessel 1 is closed off in a gastight manner by means of a plate 8 of an insulating material, which plate lies in a plane that is at least substantially perpendicular to the axis 5. Electric element 2 is mounted in a previously defined position with respect to the plate 8 during the manufacture of the lamp. The plate 8 of the lamp vessel 1 is pressed home against the base portion by locking means 9, for example ridges, such that the electric element 2 will enter a previously defined position with respect to the reference means 12, for example studs. The studs 12 form part of the lamp cap and are designed to abut against a support 30, for example a reflector, as is visible in Fig. 2.

The lamp cap also comprises contact members 14 which are provided with a screen 13 and to which the current conductors 6 of the lamp vessel 1 are connected. A resilient intermediate portion 15, which is provided with coupling means 17, resilient tags in the Figure designed for coupling the reflector to the lamp cap, forms an integral whole with the housing 11. The resilient action of the intermediate portion is obtained in that the intermediate portion is made so as to be hollow, so that no more than a wall remains as the intermediate portion, whereupon a major portion of the wall is removed by means of two grooves 18 which run perpendicularly to the axis 5. The remaining portion of the wall forms a bridge 19, which is rotated, near the next groove, through an angle of, for example, 180° about the axis 5.

The lamp vessel 1 of the electric lamp has a relatively small axial dimension of approximately 22 mm and is suitable for consuming a relatively high power of, for

example, 5 to 25 W. The electric lamp has a service life of approximately 6000 hours in this case.

In accordance with the invention, at least a part of the lamp vessel 1 is covered with a light-absorbing coating 3 having an average thickness of 2-3 μm.

Fig. 2 shows the electric lamp provided with a support 30, being a reflector with a transparent plate 33 in the drawing, as well as with an adapter 25. In this configuration of a lamp with an adapter and a reflector, where the reflector is provided with a rubber ring 31 retained in a groove 32, the rubber ring seals off the opening 26 between the lamp cap and the reflector in a gastight manner. The adapter is provided with standardized contact points 27 which are passed through the bottom plate 28 of the adapter in a gastight manner and are connected to contact members 14 of the lamp cap 10.

It is visible in the drawing that the lamp cap 10 falls substantially entirely within a cone 36 which has its apex 35 in the center 4 of the electric element 2 and has an apex half angle α of 25°. The light originating from the electric element 2 can reach the reflecting surface 34 substantially without obstruction and is reflected there at least substantially axially in the direction of the transparent plate 33.

Fig. 3 shows a cross-section of the light-absorbing coating according to the invention, applied on a glass substrate. The glass substrate is represented by reference numeral 41, while numeral 42 represent the sol-gel coating matrix. As shown in said figure the pigment particles 43 are surrounded by the Al_2O_3 particles 44 .

<u>Example 1A</u> - Preparation of a light-absorbing, red coating

A sol-gel hydrolysis mixture is made by mixing 4.5 g ethanol, 40.0 g methyltrimethoxy silane (MTMS), 0.86 g tetraethoxy silane (TEOS) and 0.14 g acetic acid, followed by the addition of in 32.0 g water and subjecting said mixture to hydrolysis for 48 hours at room temperature under continuous stirring.

A pigment dispersion is made consisting of 50% w/w iron oxide and 50% w/w organic red pigment. To this end 50 g Disperbyk 190 (a pigment stabilizer consisting of polyethyleneoxide/polypropyleneoxide) is diluted in 168 g water and 232 g ethanol. Then the inorganic-organic pigment mixture comprising 25 g Sicotrans Red 2816L (commercially available from BASF®), which is an iron oxide (Fe_2O_3) needle shaped pigment with an average particle size of about 35 nm, and 25 g Cromophtal Red A2B (Pigment Red 177 – anthraquinone) are added to the solution. The mixture was pre-dispersed with a dissolver for

about 15 minutes, subsequently the mixture was dispersed in a Dispermat SL for 8 hours with 1.25 mm yttrium stabilized zirconia milling beads. The dispersion was filtered over a 7 μm nylon filter before use.

The pigment dispersion and the sol-gel hydrolysis mixture are mixed in a weight ratio of 240 g to 80 g and 20% methoxy propanol is added. Also a wetting agent (LO50 from Wacker) is added. Just before application, the coating liquid is filtered over a 1 μm filter.

Example 1B - Preparation of a light-absorbing coating as in 1A, including Al_2O_3

A coating was prepared in the same way as in example 2, but in this case 15 g Al_2O_3 (Alon-C, commercially available from Degussa®) was added to the pigment dispersion during preparation thereof.

With both the coating from example 1A and 1B, lamps could be sprayed with color points within the top of the red color point regulations.

The level of "haze" was determined with a luminance camera for the coatings according to example 1A and 1B. The percentage of "haze" was 2.25% for the coating according to example 1A. The coating according to example 1B gave a "haze" of merely 1.3%. Thus the "haze" is reduced by 40% due to the addition of Alon-C.

Example 2 – Light-absorbing, yellow coating

Similar to example 1, coatings were prepared comprising as the pigment yellow organic PY110. Coating 2A was prepared without the addition of Al_2O_3, coating 2B was prepared using Al_2O_3 (Alon-C, commercially available from Degussa®) in an amount of 30% by weight with regard to the pigment in the dispersion.

Fig. 4 shows the diffuse transmission of the coatings 2A and 2B. It is clear that the diffuse transmission is reduced in coating 2B.

Fig. 5 shows that also in this case the addition of aluminum oxide results in a reduction of the "haze" by 40%.

As mentioned in the above, an effect of the addition of aluminum oxide to the pigments in the coating is that the temperature stability thereof is significantly increased. The colorpoint shift of lamps without aluminum oxide in the coating is larger than the colorpoint shift of lamps with aluminum oxide in the coating. Coatings 2A and 2B have been tested at

temperatures of 300°C and it was found that the transmissions after exposure to this temperature differed very much (see table below). Thus coating 2B shows an increased temperature stability of the organic pigment as well as improved lumen maintenance, compared to coating 2A.

	Initial transmission (%)	Transmission after 24 hrs at 300°C
PY110	76	59
PY110 + Al_2O_3	78	73

It will be clear that, within the scope of the invention, many variations are possible to those skilled in the art. In the sol-gel process, many alternative preparation methods are possible. Furthermore, it is also possible to use pigment combinations to cause the color point to shift towards red.

The scope of protection of the invention is not limited to the examples given herein. The invention is embodied in each novel characteristic and each combination of characteristics. Reference numerals in the claims do not limit the scope of protection thereof. The use of the term "comprising" does not exclude the presence of elements other than those mentioned in the claims. The use of the word "a" or "an" before an element does not exclude the presence of a plurality of such elements.

CLAIMS:

1. A light-transmitting substrate which is at least partly provided with a light-absorbing coating, said coating comprising a pigment which absorbs part of the visible light, characterized in that aluminum oxide is added to the coating during preparation thereof.

2. A light transmitting substrate according to claim 1, characterized in that the aluminum oxide has a particle size of 10-40 nm.

3. A light transmitting substrate according to claim 1, characterized in that the aluminum oxide has a particle size of 20-30 nm.

4. A light-transmitting substrate according to claims 1-3, characterized in that the light-absorbing coating comprises pigment particles that are incorporated in a sol-gel matrix.

5. A light-transmitting substrate according to claims 1-4, characterized in that the pigment comprises an organic pigment.

6. A light-transmitting substrate according to any one of claims 1-5, characterized in that the pigment comprises a mixture of an inorganic and an organic pigment.

7. An electric lamp comprising a light-transmitting lamp vessel that accommodates a light source, said lamp vessel comprising a light-transmitting substrate according to one or more of claims 1-6.

8. Light absorbing coating according to one or more of claims 1-6.

ABSTRACT:

Disclosed is a light-transmitting substrate that is at least partly provided with a light-absorbing coating. Said coating comprises a pigment, which absorbs part of the visible light. Moreover aluminum oxide is added to the coating during preparation thereof.

Further an electric lamp is disclosed, said lamp comprising a light-transmitting lamp vessel that accommodates a light source. Said lamp vessel comprises the above light-transmitting substrate. Moreover, a light-absorbing coating is disclosed.

Fig. 3

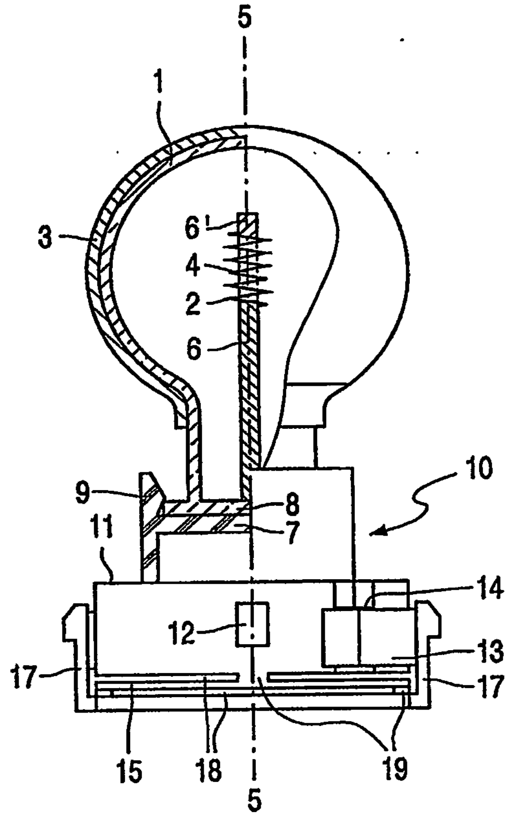

FIG. 1

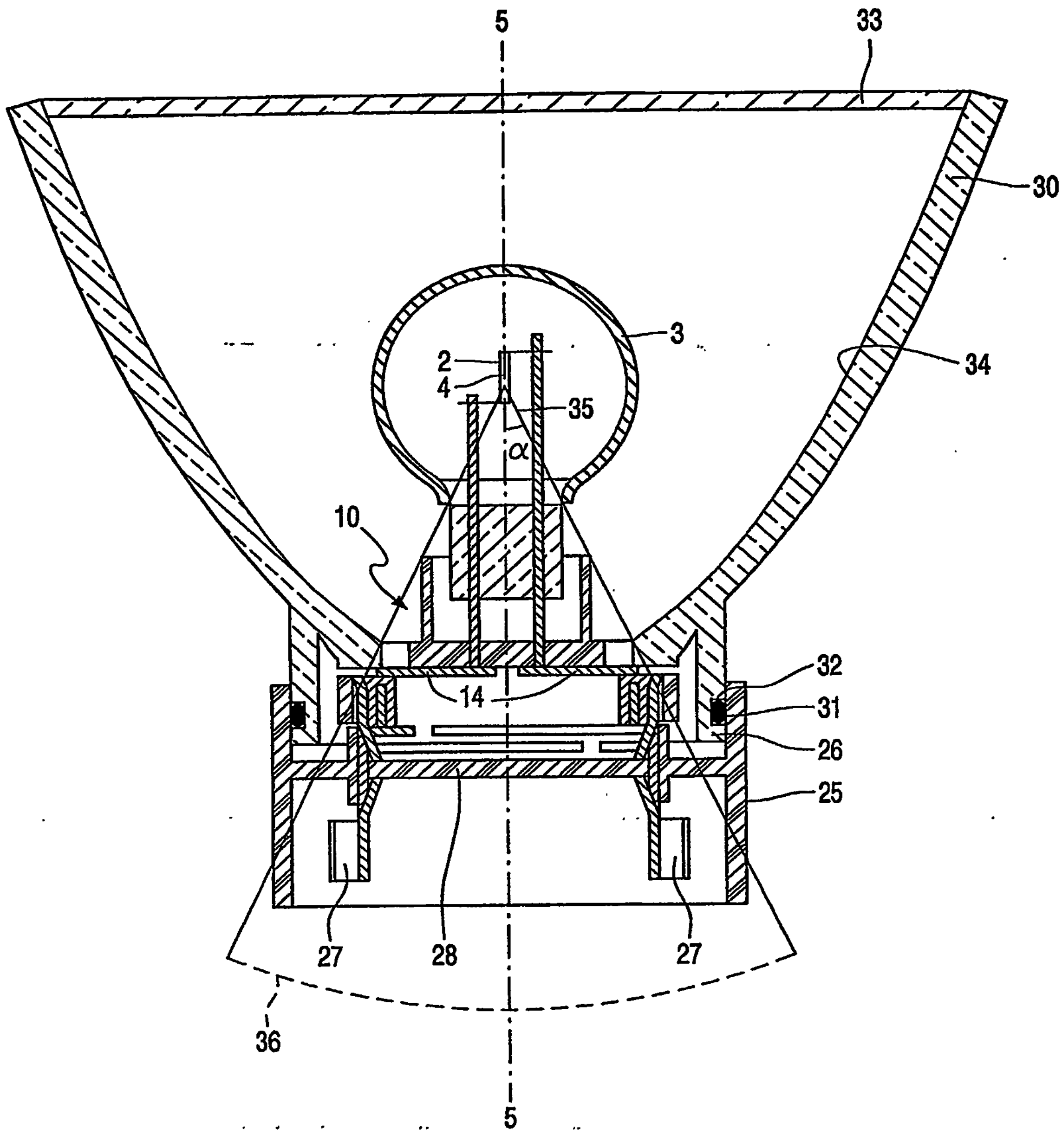

FIG. 2

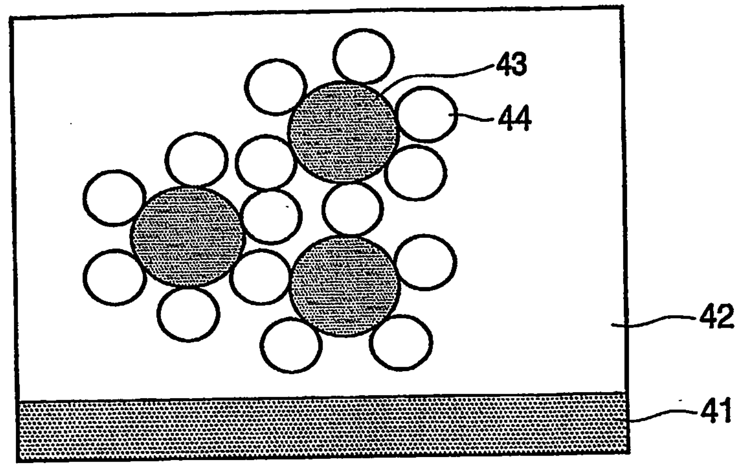

FIG. 3

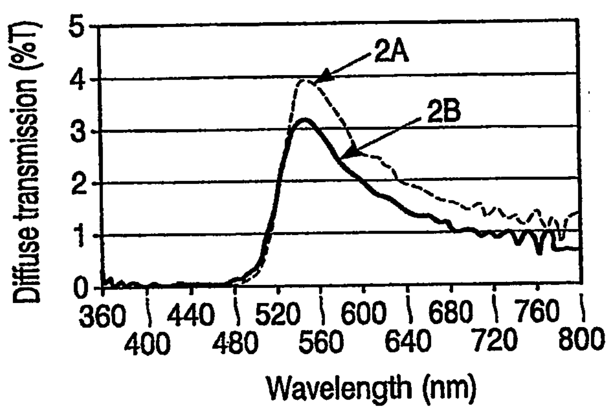

FIG. 4

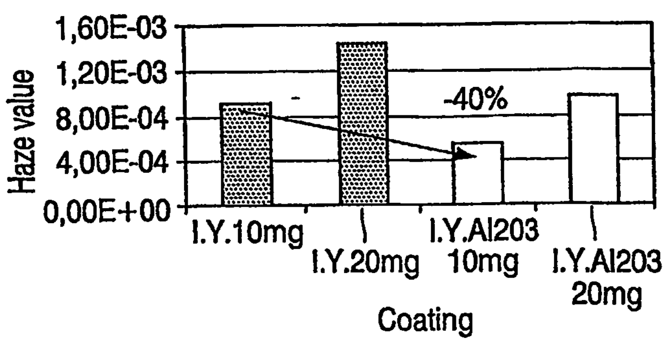

FIG. 5